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Page 2 de l'attestation**

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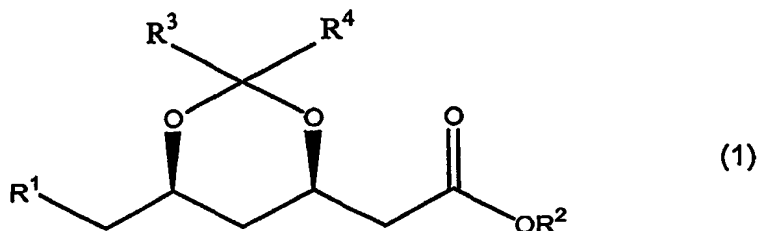
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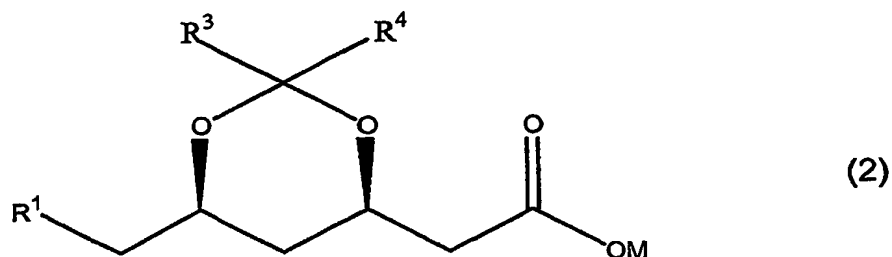
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PROCESS FOR THE PREPARATION OF AN ESTER

- 5                    The invention relates to a process for the preparation of an ester of formula (1)



- 10       wherein R<sup>1</sup> represents a leaving group, CN, OH or a COOR<sup>5</sup> group, R<sup>3</sup> and R<sup>4</sup> each independently represent a C1-3 alkyl group and R<sup>2</sup> and R<sup>5</sup> each independently represent an ester group, wherein the corresponding salt with formula (2)



- 15       wherein M represents H or an alkali (earth) metal in an inert solvent is contacted with an acid chloride forming agent to form the corresponding acid chloride, and the acid chloride is contacted with an alcohol with formula R<sup>2</sup>OH in the presence of N-methyl morpholine (NMM).

- 20                    Many processes for the preparation of esters are known in the art, for instance the preparation of esters via the formation of the acid chloride. It was, however, to be expected that such processes would not lead to high yields due to the lack of stability of the present compound under acidic conditions.

It is the object of the invention to provide a process for the

preparation of esters with high yield in a robust process, even at large scale and with relatively high concentrations.

Surprisingly it has been found that even sterically hindered esters that are difficult to obtain in esterifications like t-butyl esters of the acid unstable  
5 molecules of formula (1), can be obtained in high yield in an easily reproducible process.

With the process according to the invention esters with formula (1) that are unstable under acidic conditions, for instance with  $\text{pH} < 4$ , can be prepared in high yield.

10  $\text{R}^1$  represents a leaving group, CN, OH or a  $\text{COOR}^5$  group wherein  $\text{R}^5$  represents an ester group, for example an alkyl group with for instance 1-6 C-atoms, or an aryl group with for instance 6-12 C-atoms. A leaving group by definition is a group that can easily be replaced, for example a halogen, for instance Cl, Br or I; a tosylate group; a mesylate group; an acyloxy group, with, for instance, 1-6 C-atoms in particular  
15 an acetoxy group; a phenacetyloxy group; an alkoxy group with, for instance, 1-6 C-atoms or an (hetero) aryloxy group with, for instance, 6-12 C-atoms. Preferably  $\text{R}^1$  represents Cl.

$\text{R}^2$  represents an ester group, preferably an alkyl group, for instance an alkyl group with 1-6 C-atoms or an aryl group, for instance an aryl group with 6-12  
20 C-atoms, in particular a methyl, ethyl, propyl, isobutyl or t.butyl group. An important group of esters that can be prepared with the process according to the invention are t.butyl esters.

$\text{R}^3$  and  $\text{R}^4$  each independently represent a C1-C3 alkyl group, for instance a methyl or ethyl group. Preferably  $\text{R}^3$  and  $\text{R}^4$  both represent methyl.

25 The metal M in formula (2) can be chosen from the group of H, alkali metals, for instance lithium, sodium, potassium and alkali earth metals, for instance magnesium or calcium. Preferably M represents sodium or potassium.

The acid chloride forming agent can be chosen from the group of reagents that is generally known as such. Suitable examples of acid chloride forming  
30 agents are oxalyl chloride, thionyl chloride,  $\text{PCl}_3$ ,  $\text{PCl}_5$ , and  $\text{POCl}_3$ . Preferably the acid chloride forming agent is used in an excess relative to the amount the salt with formula (2), for instance between 1 and 3 equivalents, more preferably between 1.2 and 1.8 equivalents.

If desired, in the acid chloride formation also a catalyst may be  
35 present. The amount of catalyst may for instance vary from 0-1, preferably 0-0.5 equivalents, calculated with respect to the amount of salt with formula (2). Higher

amounts of catalyst are also possible, but will normally have no extra advantageous effect. Preferably the amount of catalyst, if any, will be between 0.05 and 0.2 equivalents calculated with respect to the salt with formula (2). Suitable catalysts are the catalysts generally known to accelerate acid chloride formation, for instance  
5 dimethylformamide (DMF) and N-methylpyrrolidone (NMP).

The conversion of the acid chloride into the ester with formula (1) is carried out in the presence of an alcohol with formula  $R^2OH$ . The amount of alcohol with formula  $R^2OH$  is not very critical and preferably is between 1 and 15 equivalent calculated with respect to the amount of salt with formula (2), more preferably between  
10 2 and 13, most preferably between 3 and 6. Surprisingly it has been found that even t.-butyl esters can be prepared with high yield using a relatively low amount of t.-butyl alcohol.

The conversion of the acid chloride into the ester with formula (1) is carried out in the presence of NMM. In practice a small amount of NMM, efficient to  
15 catch eventually remaining free HCl, for instance 1.5 to 2.5, preferably 1.8 to 2.0 equivalents calculated with respect to the amount of salt with formula (2) is applied. When a large excess of acid chloride forming agent is used, preferably higher amounts of NMM are used, and when a lower excess of acid chloride forming agent is used, preferably lower amounts of NMM are used.

The acid chloride formation reaction preferably is carried out at a temperature between  $-30^{\circ}$  and  $60^{\circ}C$ , more preferably between  $20$  and  $50^{\circ}C$ . The conversion of the acid chloride into the ester with formula (1) preferably is carried out at a temperature between  $20$  and  $80^{\circ}C$ , more preferably between  $20$  and  $50^{\circ}C$ .

The process of the present invention may be carried out in one step.  
25 Preferably first the salt with formula (2) is converted into the corresponding acid chloride, and subsequently the acid chloride is contacted with the alcohol with formula  $R^2OH$  and NMM. In a particularly preferred embodiment the acid chloride formed is quenched with NMM and the alcohol with formula  $R^2OH$ .

The invention will be elucidated by the following examples.

30

#### Example I

1864 g of an aqueous solution of the (4R-cis)-(6-chloromethyl)-2,2-dimethyl-1,3-dioxane-4-yl-acetic acid, sodium salt (3.31 moles) and 4.8 L of toluene were mixed and water was removed by azeotropic distillation under reduced pressure. Subsequently,  
35 870 g of fresh toluene were added and removed by distillation. To the obtained

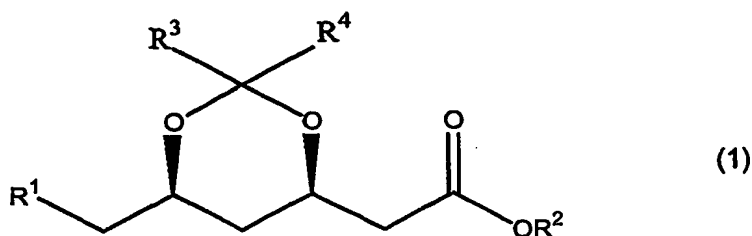
suspension was added, 588 g of oxalyl chloride, while maintaining the temperature at 20 °C. The resulting mixture was stirred for 6 hours at 20-25 °C and then slowly added to a mixture of 979 g of t.-butanol and 836 g of *N*-methyl morpholine. After stirring for 1 hour, 3966 g of an 8% (w/w) aqueous NaOH solution was added and the resulting  
5 mixture stirred for 1.5 hours at 40 °C. After washing the organic phase with 3300 g of water, 3064 g of a toluene solution of the desired t.-butyl ester was obtained, corresponding to 751 g (81%) of product.

Example II

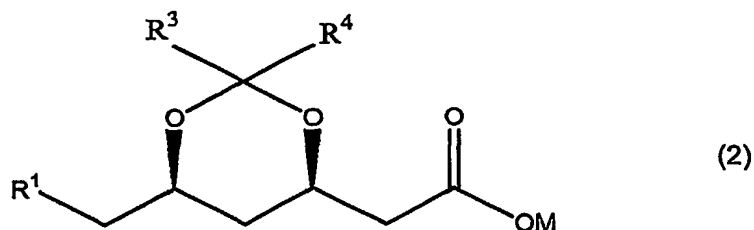
10 In a 100 ml HEL Vessel with 4 blade stirrer 8.0 g (4R-cis)-(6-chloromethyl)-2,2-dimethyl-1,3-dioxane-4-yl-acetic acid, sodium salt (92.4%; 30 mmol) was suspended in 41 g toluene and 0.3 g NMP (3 mmol). In 1h 4.5 g (36 mmol) oxalylchloride was dosed at a temperature of 15-20°C. The reaction mixture (50 g) was stirred for 2.5 hours. The reaction mixture was split into 2 parts: Part A (23.83 g) and part B (24.25 g). Part A of  
15 the reaction mixture was dosed during 1 h. to a mixture of 22.2 g (20 eq.) t.-butanol and 3.0 g (2 eq.) NMM at 25°C. The reaction mixture was stirred overnight and analyzed by GC. The yield of the t.-butyl ester was 88%.

CLAIMS

1. Process for the preparation of an ester of formula (1),



10 wherein R<sup>1</sup> represents a leaving group, CN, OH or a COOR<sup>5</sup> group, R<sup>3</sup> and R<sup>4</sup> each independently represent a 1-3 C alkyl group, and R<sup>2</sup> and R<sup>5</sup> each independently represent an ester group, wherein the corresponding salt with formula (2),



wherein M represents H or an alkali (earth) metal in an inert solvent is contacted with an acid chloride forming agent to form the corresponding acid chloride, and the acid chloride is contacted with an alcohol with formula R<sup>2</sup>OH in the presence of N-methyl-morpholine.

- 20 2. Process according to claim 1, wherein M represents an alkali metal.
3. Process according to claim 1 or 2, wherein R<sup>2</sup> represents an alkyl group.
4. Process according to claim 3, wherein R<sup>2</sup> represents a t.-butyl group.
5. Process according to any one of claims 1-4, wherein the acid chloride forming agent is oxalylchloride.
- 25 6. Process according to any one of claims 1-5, wherein the acid chloride formation is performed in the presence of a catalyst.
7. Process according to any one of claims 1-6, wherein the amount of alcohol

with formula  $R^2OH$  is between 3 and 6 equivalents calculated with respect to the amount of salt with formula (2).

- 5
8. Process according to any one of claims 1-7, wherein first the salt with formula (2) is converted into the corresponding acid chloride and subsequently the acid chloride is contacted with the alcohol with formula  $R^2OH$  and N-methyl-morpholine.
  9. Process according to claim 8, wherein the acid chloride is quenched with the alcohol with formula  $R^2OH$  and N-methyl-morpholine.

### ABSTRACT

Process for the preparation of an ester of formula (1), wherein  $R^1$  represents a leaving group, CN, OH or a  $COOR^5$  group,  $R^3$  and  $R^4$  each independently represent a 1-3 C alkyl group, and  $R^2$  and  $R^5$  each independently represent an ester group, wherein the corresponding salt with formula (2), wherein M represents H or an alkali (earth) metal in an inert solvent is contacted with an acid chloride forming agent to form the corresponding acid chloride, and the acid chloride is contacted with an alcohol with formula  $R^2OH$  in the presence of N-methyl-morpholine. Preferably M represents an alkali metal, and  $R^2$  represents an alkyl group, particularly a t.-butyl group.

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